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1. A method of molding a multiplicity of devices (12) extending from a common base (10) by use of a large multiplicity of mold plates (250) held face to face, comprising

forming mold cavities (1) of the shape of the devices in the edges of the mold plates,

assembling the plates face-to-face to provide a mold surface, the sides of some of the plates closing cavities in the sides of other of the plates,

positioning the mold surface opposite another surface with a gap (G) therebetween,

filling the volume between the mold surface and the opposed surface with molten resin, and,

after hardening of the resin, withdrawing the molded devices and integral base from the mold surface;

characterized in that the mold cavities (1) are formed by photochemical techniques employing, upon the sides of the plates, a mask, the shape of which approximates, but varies from, the desired profile of the device or a portion of the device to be molded (See Figs. 15 and 16) to compensate for nonuniformities of a predetermined etching process, and with the predetermined process, etching the exposed metal of the plate as defined by the mask to provide the desired mold cavity.

2. The method of claim 1 including forming a touch fastener component (100) by use of a large multiplicity of mold plates (250 or 151) held face to face, comprising

forming mold cavities (1) of the shape of the fastener shape in the edge of the mold plates,

assembling the plates face-to-face to provide a mold surface, the sides of some of the plates closing cavities in the sides of other of the plates,

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positioning the mold surface opposite another surface, with a gap (G) therebetween,

filling the volume between the mold surface and the opposed surface with molten resin, and,

after hardening of the resin, withdrawing the molded fasteners and integral base from the mold surface.

3. The method of claim 1 or 2 in which a plurality of plates are etched using corresponding masks to form a single device or fastener (Fig. 6) and the plates are assembled in registry with one another.

4. The method of claim 3 in which at least some of the plurality of plates are laminated together to form a thicker plate assembly.

5. The method of any of the foregoing claims wherein at least two of the plates have mating mold cavity portions that together define a relatively sharp point (See e.g. Figs. 9b, 12).

6. The method of claim 5 wherein the mold cavity (1) defines a hook component (12) of a hook and loop fastener, the sharp point (See e.g. Fig. 9b) residing on a portion of the hook exposed to engage loops or fibers of a mating component.

7. The method of Claim 6 in which the sharp point is defined at the top of the hook (Fig. 9b), positioned to be the first portion of the hook to contact the loop or fibers of a loop component against which the hook component moves face-wise.

8. The method of claim 7 in which the sharp point (406) is at the distal tip of a crook of the hook,

for engaging a loop and directing it into a loop capture area (408) of the hook.

9. The method of Claim 8 in which the top portion of the crook lies within an included angle α of less than 30 degrees.

10. The method of claim 8 or 9 in which the forming method is adapted to produce a tip (406) that tapers to a relatively sharp point in both end and side views (Figs. 18 and 21).

11. The method of any of the foregoing claims in which the mold cavity defines a hook component of a hook and loop fastener, the hook component having a crook ending in a distal point, the edge or edges of the mask defining the distal tip being oversized (D, 601) and the edge or edges of the mask defining the concave curve being undersized (E, Fig. 15; Fig. 16).

12. The method of any of the foregoing claims in which the mold cavity defines a hook member (400) of a hook and loop fastener, the hook member having a crook portion (402) ending in a distal point (406), the inner surface (412) of the crook being concave and enclosing a loop capture area (408), the edge or edges of the mask defining the concave curve being undersized (E, Fig. 15; Fig. 16).

13. The method of any of the foregoing claims in which the mold cavity defines a hook member (400) of a hook and loop fastener, the hook member having a crook portion (402) ending in a distal point (406), the upper edge of the crook being convex and the edge or edges of

the mask defining this convex edge being oversized (C Fig. 15; Fig 16).

14. The method of any of the foregoing claims in which the mold cavity defines a hook component of a hook and loop fastener, the hook component (Fig. 19) having a crook portion (402) ending in a distal tip (406), the a tip portion directed toward the base (10), and an inner surface (412) defines an apex (414) which is substantially closer to the stem (404) or pedestal of the hook than to the tip (406).

15. The method of any of the foregoing claims wherein the mask defines a hook (Fig 19) and

(a) the tip (406) of the crook portion of the hook, in profile in the plane of the extended direction of the crook portion (Fig. 19A), is substantially pointed, defining an included angle of less than about 30 degrees,

(b) the neutral axis (407) of the crook portion in the vicinity of the tip (406) is directed substantially downward toward the base,

(c) the curvature of the concave inner-surface of the crook gradually decreases in radius from the tip along the inner surface (412) to the apex (414), and

(d) the apex (414) of the hook capture area (408) is located laterally closer to the stem or pedestal (404) than to the tip (406) of the crook portion.

16. The method of any of the foregoing claims in which the mold cavity defines a hook member (400, 12) of a hook and loop fastener, the hook member having a crook portion (402, 14) ending in a distal tip (406, 16);

(a) the edge surfaces of the plates directed toward said gap being formed to positional accuracy of at most 0.001 inch from a mean dimension at the edge of the plates; and

(b) the gap thickness (t_b) is less than about 0.003 inch, whereby an ultra-thin molded fastener tape is formed.

17. The method of claim 16 in which the base thickness (t_b) is less than about 0.002 inch.

18. The method of any of the foregoing claims in which the mold cavity defines a hook component (12) of a hook and loop fastener, the hook component having a crook portion ending in a distal tip, and the plates comprise a hardened copper alloy.

19. The method of claim 18 wherein the alloy is copper beryllium.

20. The method of any of the foregoing claims in which the mold cavity (1) defines a hook component (450) of a hook and loop fastener, the hook component having a crook portion (452b) ending in a distal tip, wherein at least the crook portion of the hook extends in a direction at an angle to the plane of the plates, the shape of the crook being defined by cut-outs in a plurality of plates.

21. The method of any of the foregoing claims in which a given plate has cavity portions formed in each of its sides, the cavities being offset from one another and overlapped in the manner that the combined depth of penetration of the cavities into the depth of the plate exceedes the plate thickness (see Fig 25).

22. The method of claim 21 in which the cavities define at least portions of hooks for a hook and loop fastener, the effective overlap of the cavities enabling a high density of hooks to be achieved in the hook component.

23. The method of any of the foregoing claims in which the plates define a mold roll and the molten resin is introduced to the mold roll by an extruder (Figs. 4 or 4D).

24. The method of claim 23 in which a pressure roll (82) defines a nip with the mold roll and the extruded plastic forms a dam of molten plastic at the nip.

25. The method of claim 23 in which a the extruder includes a nozzle for delivering molten resin under pressure against the mold roll.

26. The method of any of the claims 23-25 in which cooling fluid cools the plates.

27. The method of claim 26 in which the plates comprise a copper based alloy.

28. The method of claim 27 in which the alloy is copper beryllium.

29. A method of forming a multiplicity of devices extending from a common base (10) with a large multiplicity of mold plates (250, 151) held face to face, comprising

forming mold cavities (1) of shape of the devices in the edge of at least many of the mold plates,

assembling the plates face to face to provide a mold surface, the sides of some of the plates closing cavities in the sides of other of the plates,

positioning the mold surface opposite another surface with a gap (G) therebetween,

filling the volume between the mold surface and the opposed surface with molten resin, and,

after hardening of the resin, withdrawing the molded devices and integral base from the mold surface,

characterized in that the mold surface is formed by a chemical etchant to provide a surface roughness of less than about 75 microinches.

30. The method of claim 29 in which the etchant provides a surface roughness of less than about 60 microinches.

31. The method of claim 29 or claim 30 in which the surface of the cavities are produced in finished form by photochemical techniques.

32. The method of claim 31 in which the photochemical techniques produce an edge surface on the respective plates with a dimensional tolerance of less than about 0.001 inch.

33. The method of claim 32 in which the photochemical techniques produce a dimensional tolerance of less than about 0.0005 inch.

34. The method of claim 29 or 30 in which photochemical etching techniques are employed to form the cavities, following which the plates are assembled face-to-face and machined to a desired dimensional tolerance, and subsequently the plates, while remaining assembled,

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are etched to remove burrs extending into the mold cavities.

35. The method of claim 29 or 30 in which the cavities of the plate are preformed, the plates are assembled face-to-face and machined to a desired dimensional tolerance, and subsequently the plates, while remaining assembled, are etched to remove burrs extending into the mold cavities.

36. The method of claim 34 or 35 in which the plates are of copper beryllium and the burrs, being work hardened, are preferentially removed by the etchant.

37. A molding apparatus comprising:

a series of mold plates (250) held together face to face to define, at the edges of the plates, a series of mold cavities (1) shaped to form fastener elements, and

an opposed forming member (510), the edges of the plates (250) and the surface of the opposed member (510) defining a mold gap (G) in which a base layer (10), integral with the fastener elements (12), is formed when the mold cavities and the space between the edges of the plates and the opposed forming surface are filled with moldable resin, wherein

(a) the edge surfaces of the plates (250) directed toward said gap are formed to positional accuracy from part to part of at most 0.001 inch with respect to a mean value at the edge of the plates and

(b) the gap thickness t_b is less than 0.003 inch, whereby an ultrathin molded fastener tape is formed.

38. The molding apparatus of claim 37 in which the positional accuracy is at most 0.0005 inch.

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39. The molding apparatus of claim 37 or 38 wherein the mold plates comprise a hardened copper alloy.

40. The molding apparatus of any of claims 37-39 wherein the mold plates comprise a copper beryllium alloy.

41. The molding apparatus of claim 40 wherein the mold plates comprise a copper alloy containing about 1.9 percent beryllium, by weight.

42. The molding apparatus of any of claims 37-41 wherein the plates are circular, assembled in a stack to form a cylindrical mold roll (80), and the opposed member is constructed tofor apply molten plastic to the roll.

43. The molding apparatus of claim 42 wherein the opposed member comprises a pressure roll (82) forming a nip with the mold roll (80) into which nip molten plastic is introduced, the gap (G) between the mold and pressure rolls being less than about 0.003 inch to determine the thickness (t_b) of the base of the fastener.

44. The molding apparatus of claim 42 wherein the opposed member comprises a surface (480) of an extruder, the surface held from the mold roll at a gap (G) of less than about 0.003 inch to determine the thickness (t_b) of the base of the fastener.

45. The molding apparatus of claim 42 wherein the opposed member defines with the plates an injection mold.

46. The molding apparatus of any of claims 37-45 in which surfaces defining said fastener-form mold

cavities have a surface roughness of less than about 75 microinches.

47. The molding apparatus of claim 46 in which surfaces defining said fastener-form mold cavities have a surface roughness of less than about 60 microinches.

48. The molding apparatus of any of claims 37-47 in which the surfaces defining the fastener mold cavities are of chemically etched form.

49. The molding apparatus of any of claims 37-48 in which the surfaces of the mold have a photochemically-etched contour.

50. The molding apparatus of any of claims 37-48 in which surfaces of the mold are preformed surfaces having a chemically etched and deburred surface finish.

51. The apparatus of claim 50 wherein the preformed surface is a machined cylindrical surface produced on a lathe, milling or grinding machine.

52. The apparatus of claim 50 wherein the preformed surface is a surface formed by EDM.

53. The apparatus of claim 50 wherein the preformed surface is a surface formed by laser cutting.

54. A molding apparatus comprising:

a series of mold plates (250) held together face to face to define, at the edges of the plates, a series of mold cavities (1) shaped to form fastener elements and,

an opposed forming surface (510), the edges of the plates (250) and the surface of the opposed forming member defining a mold gap (G) in which a base layer (10), integral with the fastener elements (12) , is formed when the mold cavities and the space between the edges of the plates and the opposed forming surface are filled with moldable resin, wherein

the plates comprise a hardened copper alloy and the surface of the cavities is a chemically etched surface.

55. The apparatus of claim 54 wherein the alloy comprises copper beryllium.

56. The apparatus of claim 54 or 55 wherein the surface roughness of surfaces of the mold cavities is less than about 75 microinches.

57. The apparatus of ~~claim 56~~ wherein the surface roughness of surfaces of the mold cavities is less than about 60 microinches.

58. The apparatus of any of the claims 54-57 wherein the plates are preformed by photo chemical techniques and assembled as a stack, and the stack as a whole has a dimensional tolerance of less than about 0.001 inch.

59. The apparatus of claim 58 wherein the tolerance is less than about 0.0005 inch.

60. A hook element for engaging a loop element, the hook element comprising a base (10) and a large multiplicity of loop-engageable hooks (12) molded integrally with the base, characterized in that the base

comprises a plastic resin and has a thickness (t_b) less than about 0.003 inch.

61. The hook component of claim 60 wherein the base has a thickness (t_b) of less than about 0.002 inch.

62. The hook component of claim 60 or 61 wherein the hook is molded of a thermoplastic material.

63. For a touch fastener, a molded hook member (12) supported by a base (10), the hook member having a pedestal or stem portion extending from the base, and at least one crook portion (402, 452, 474, 478 or 484) integral with and curving laterally from the top of the pedestal or stem portion, the profile of the crook portion in the plane of the stem of the hook tapering along its neutral axis (407) toward its distal tip (406), the distal tip portion of the crook portion being spaced laterally from the stem or pedestal to define a loop capture area (408) having an apex (414), characterized in that:

(a) the crook portion, in the direction of extension of the crook, is substantially pointed, defining an included angle ($\alpha_{x,y}$) of less than about 30°,

(b) the neutral axis (407) of the crook portion is directed substantially directly downward toward the base (10) at the crook tip (406),

(c) the curvature of the inner surface (412) of the crook portion decreases in radius from the tip to the apex, and

(d) the apex (414) of the hook capture portion is located laterally closer to the stem or pedestal than to the tip of the crook portion.

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64. The molded hook of claim 63 in which the apex of the loop capture area is spaced from the tip of the crook portion a distance (δ_1) of more than about two-thirds, preferably more than about three-fourths, of the lateral distance (δ_2) from the outermost portion (410) of the crook to the stem or pedestal (404).

65. The molded hook of claim 63 or 64 characterized in that the thickness of the crook portion out of the plane of the direction of extension of the crook (Fig. 21) tapers, narrowing toward the tip of the crook portion.

66. The molded hook of claim 65 in which the tip portion of the crook, in transverse profile (Fig. 21), is substantially pointed, defining an included angle (α_{21}) of less than about 30 degrees, and is directed substantially downwardly directly toward the base.

67. The molded hook of any of claims 63-66 in which, in transverse profile (Fig. 21), the crook portion has one side (422) that is straight and one side (424) that is convex, curved in the manner to have cross-sections taken perpendicular to the neutral axis that are relatively thick at the axis and thinner toward the upper and lower edges of the crook.

68. The molded hook of any of claims 63-67 in which, in transverse profile (Fig. 21), the crook portion has two sides that are oppositely convex (Fig. 20A), such that cross-sections taken perpendicular to the neutral axis are relatively thick at the axis and thinner toward the upper and lower surfaces of the crook.

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69. The molded hook of any of claims 63-68 in which the inner surface (412) of the crook portion in the vicinity of the tip (406) defines an angle (ψ_1) with a perpendicular to the base.

70. The molded hook of any of claims 63-69 in which the inner surface (412) of the crook portion, from the tip (406) to the apex (414), defines an overall inclination angle (ψ) with a perpendicular to the base.

71. The molded hook of any of claims 63-70 in which the cross-sectional area of the crook portion (402), in planes perpendicular to the neutral axis (407) of the crook portion, increases substantially linearly as a function of distance along the neutral axis from the tip (406).

72. The molded hook of claim 63 in which the upper surface of the crook portion is substantially of wedge shape.

73. The molded hook of Claim 72 in which the wedge shape is defined by the intersection of a flat side (422) of the crook portion and an oppositely directed convex side (424) of the crook portion.

74. The molded hook of Claim 72 in which the wedge shape is defined by the intersection of two oppositely directed convex sides of the crook portion.

75. The molded hook of any of claims 63-74 wherein the inner surface (412) of the crook portion (402) is of substantially elliptical form, the major axis of the ellipse forming an angle with the normal to the base of not more than about 30 degrees.

76. The molded hook of any of claims 63-75 characterized in being of a form capable of being molded in a fixed mold and removed therefrom by pulling the hook from the cavity without opening or moving parts of the mold.

77. The molded hook of claim 76 having a smooth surface corresponding to a photochemically milled surface of its corresponding mold cavity.

ADD A1

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